COURSE DESCRIPTION CARD - SYLLABUS

Course name
Management of waste from inorganic industries [S2TOZ1>ZOPzPN]

Course

Field of study
Circular System Technologies

Year/Semester
1/2

Area of study (specialization)
Renewable raw material technologies

Profile of study
general academic

Level of study
second-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
30

Other
0

Tutorials
15

Projects/seminars
0

Number of credit points

6,00

Coordinators

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Lecturers

Prerequisites

Structured and systematic knowledge of natural and inorganic raw materials in inorganic chemical technology (core curriculum of full-time undergraduate studies). Ability to solve elementary engineering problems of inorganic chemical technology on the basis of the knowledge possessed. The ability to acquire information from indicated sources in Polish and foreign language. Understanding the need for further education, understanding the necessity of broadening one's competence, and willingness to cooperate within a team.

Course objective

To acquire a structured and reinforced knowledge of the technologies and potential directions of waste management from the paint and lacquer industry or the textile industry and the reuse (material and raw material recycling) of materials from aluminum, glass or paper. Familiarity with basic industrial processes and unit operations associated with the aforementioned technologies. To be able to define and design basic industrial processes and unit operations and to select/select the method of regeneration/reuse of raw and semifinished materials, products and waste substances necessary to close their circulation in the environment. To learn about production technologies and identify the waste streams generated during their implementation. Identify opportunities for the management/recycling of post-production waste generated by implemented technological processes. To become acquainted with methods of reducing the harmful effects of technological processes on the environment. Acquisition of basic information related to the closed-loop economy. Proposition to use of environmentally friendly technologies. Materials and energy balances of selected technologies.

Course-related learning outcomes

Knowledge:
K_W01 - has in-depth knowledge of physics, chemistry, and other related fields relevant to the studied major, useful for describing and solving complex tasks in the field of studied major.
K_W02 - has advanced, structured and theoretically grounded knowledge of the principles of a circular economy and the reasons why it is implemented.
K_W04 - has structured, advanced knowledge to recognize, assess the harmfulness and neutralize factors hazardous to the environment.
K_W06 - has extended knowledge to recognize and differentiate factors hazardous to the environment and knows the principles of waste neutralization and recovery taking into account the requirements of a closed-loop economy.
K_W07 - has extended knowledge to design technological processes based on the principles of closed-loop economy.
K_W08 - has an extended knowledge of the social, ethical, economic, and legal-administrative aspects of enterprise operation in a closed-loop economy.
K_W12 - has in-depth knowledge of material, recycling methods, raw material and energy recovery from waste materials necessary to design, optimize, and implement innovative technological processes.
K_W13 - has a structured and theoretically underpinned knowledge covering the selection of the raw material, methodological, and apparatus base for the realization of state-of-the-art technologies based on the principles of a circular economy.

Skills:
K_U01 - has an ease of verbal communication with specialists in the area of the circular economy and related fields.
K_U02 - is able to plan, prepare, and present a presentation on the implementation of a research task and conduct a substantive discussion on a given topic.
K_U03 - has the ability to use the knowledge to identify and select methods of disposal/management of various industrial wastes taking into account the principles of closed-loop economy and to propose improvements to existing technological solutions taking into account the applicable legal acts.
K_U04 - is able to identify and critically evaluate technical solutions for waste recycling in accordance with the principles of a closed-loop economy.
K_U05 - can independently plan and implement own lifelong learning to improve personal professional competences.
K_U09 - can interact with others and take a leading role in a team to solve engineering problems concerning methods and equipment used in technologies, including those related to the closed-loop economy.
K_U10 - has the ability to select methods of recycling, chemical recovery and disposal of various wastes and to formulate the assumptions necessary to design innovative solutions based on the principles of the closed-loop economy.
K_U11 - has the ability to qualify selected waste materials and apply appropriate recycling and recovery techniques, in compliance with current legislation.
K_U13 - can evaluate the quality of reprocessed waste materials, as well as qualify them for further use in various industries.
K_U16 - can analyze and critically evaluate new areas in closed-loop technologies and related fields, assess their innovativeness and technical feasibility.

Social competences:
K_K01 - is aware of personal responsibility resulting from the professional role and of the emergence of moral and ethical issues in the context of professional activities.
K_K02 - understands the need to popularize knowledge on sustainable production and technological solutions in a closed-loop economy.
K_K03 - critically evaluates his/her knowledge, understands the need for further education, and improvement of his/her professional, personal, and social competences.
K_K04 - is able to think and act in an entrepreneurial way, while being aware of his/her social role and public interest.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture: Stationary form - the knowledge acquired during the lecture is verified in the form of a written exam after the completed cycle of lectures. The exam consists of 4-6 open questions. Online form - the knowledge acquired during the lecture is verified in the form of a written exam after the completed cycle of lectures via the eKursy platform. The exam includes 20-30 closed test questions (multiple choice), to which students answer using the test module on the eKursy platform. Assessment criteria in accordance with the Regulations for first-cycle and second-cycle studies (section C, paragraph 21, point 2).
Laboratory: Stationary form - oral answer or written test (3-5 questions) from the material contained in the exercises and the given theoretical issues; presence and realization of all laboratory exercises provided in the study program; grade from reports prepared after each exercise. If a student fails to pass the theoretical part of a given exercise, they are required to retake the assessment. In addition, in order to pass, students must submit and have their report for each exercise accepted. Online form - oral answer and/or written test (10-20 closed, multiple choice test questions) from the material contained in the exercises, tutorial videos and the theoretical issues provided, conducted in the "live view" mode with the webcam turned on via eMeeting or Zoom platform during a direct conversation with the teacher and/or using the test module on the eKursy platform; online presence and completion of all laboratory exercises provided in the study program; grade from the reports prepared after each exercise and sent via the eKursy platform or by e-mail using the university's e-mail system. A final grade will be given based on the average grade of the oral/written answers. If a student fails to pass the theoretical part of a given exercise, they are required to retake the assessment. In addition, in order to pass, students must submit and have their report for each exercise accepted. Assessment criteria in accordance with the Regulations for first-cycle and second-cycle studies (section C, paragraph 21, point 2).

Programme content

1. Technology and recycling of glass products.
2. Closed loop aspects of textile industry waste.
3. Technology and recycling of wood-cellulose-paper products.
4. The management and regeneration of products/waste from the paint and varnish industry - trends and prospects.
5. Technology and recycling of aluminum products.
6. Technology and recycling of ceramic products.

Course topics

1. Technology and recycling of glass products - the properties of glass; the course of the glass manufacturing process - with particular emphasis on the processing of glass mass into products, raw materials used in the production of glass, reduction in the energy consumption of glass manufacturing processes with the use of alternative raw materials or technological operations allowing for a reduction in CO2 emissions, the latest solutions in the selection of refractory linings; unconventional methods for the production of glass; tinting and decolorization of glass; glassworks and the environment; trends and prospects in light of the challenges faced by the glass industry; management of glass waste; recycling of glass waste.
2. Closed-loop aspects of textile industry waste: overview of technologies and installations in the textile industry: mechanical processing of textile raw materials, prewashing of fibers, chemical treatment processes for textiles; assessment of technologies in terms of raw material base, material intensity, and energy intensity; identification of emission sources and types of waste substances entering the

environment; methods and techniques to reduce emissions of pollutants; mechanical and chemical recycling of waste from the textile industry; chemical decomposition of textile waste; trends and perspectives in the development of the textile industry.
3. Technology and recycling of wood pulp and paper products - properties, classification and application of paper products; raw materials for paper production and their preparation; auxiliary raw materials; course of the paper production process; identification of waste streams generated during paper production and their management; recycling of paper products; limitations and perspectives of waste water treatment in the wood pulp and paper industry.
4. Management and regeneration of products/wastes of the paint and varnish industry - trends and perspectives - historical overview; composition of paints and varnishes; production process flow; identification of waste streams generated by the paint and varnish industry; technological treatments to reduce waste generation, management, and regeneration of products/wastes of the paint and varnish industry.
5. Technology and recycling of aluminum products: an overview of the technology of aluminum production including the latest trends; raw materials and their preparation; identification of waste streams generated during aluminum production and methods for their regeneration/management; environmental impact and opportunities for waste heat recovery.
6 Technology and recycling of ceramic products: process flow in the manufacture of ceramic materials (tiles, sanitary ceramics, white goods), raw materials and their preparation; identification of waste streams generated during the manufacture of ceramic products, recycling of products.

Teaching methods

Lecture - curriculum content presented in lecture is delivered in the form of a multimedia presentation.
Laboratory - didactic materials for the laboratory are provided in the form of pdf files, practical exercises.
Exercises - multimedia presentations, illustrated with examples on the blackboard, performance of tasks given by the instructor - practical (accounting) exercises, group work, discussion of the posed scientific problems.

Bibliography

Basic:
1. Collective work: I. Płoński, K. Łyskiakowa, H. Pieniążek, Technologia szkła, Arkady, Warszawa 1972 r.
2. Collective work: Technologia szkła. Właściwości fizykochemiczne. Metody badań. Część 2, Ceramika / Ceramics, vol. 113, Kraków 2012 r.
3. Collective work: Technologia szkła. Właściwości fizykochemiczne. Metody badań. Część 1, Ceramika / Ceramics, vol. 73, Kraków 2002 r.
4. S. Jakucewicz, Wstęp do papiernictwa, WPW, Warszawa 2014 r.
5. K. Przybysz, Technologia papieru, Cz.1. Papiernicze masy włókniste, WPŁ, Łódź 2007 r.
6. K. Przybysz, Technologia celulozy i papieru. Technologia papieru. Cz. 2. Wydawnictwa Szkolne i Pedagogiczne, Warszawa 1997 r.
7. P. Wandelt, Technologia celulozy i papieru: Technologia mas włóknistych. Wydawnictwa Szkolne i Pedagogiczne, 1996 r.
8. M. Doble, A. Kumar, Paper and pulp biotreatment of industrial effluents, 1st ed.. Burlington: Butterworth-Heinemann; 2005 r.
9. H. Holik, Handbook of paper and board. Germany: Wiley-VCH; 2006 r.
10. Ç. Çakanyıldırım, M. Gürü, Developments in Aluminum Production Technologies, Environmental Impact, and Application Areas. Journal of Polytechnic, 24 (2021) 585-592.
11. B. Berdiyarov, S. Khojiev, S. Rakhmataliev, M. Syunova, N. Rasulova, Modern Technologies of Aluminum Production, International Journal of Engineering and Information Systems, 5 (2021) 100-105.
12. R. Talbert, Paints Technology Handbook, Taylor & Francis group, Boca Raton & New York & London, 2008 r.
13. T. Brock, M. Groteklaec, P. Mischke, European Coating Handbook, Vincentz, 2010, pp. 3-430.
14. S. Jusupow, Technologia produkcji wyrobow ceramicznych, Wydawnictwo Nasza Wiedza, 2021.

Additional:
1. Specialist scientific literature „Świat szkła”, „Ceramika i szkło”.
2. A. Goldschmidt, H. Streitberger, Handbook on Basics of Coating Technology, BASF, 2007 r.
3. R. Lambourne, T.A. Strivens, Paint and surface Coatings theory and practice, second edition,

Woodhead Publishing Ltd, Cambridge 1999 r.
4. H. Kvande. Fundamentals of Aluminium Metallurgy: Production, Processing, and Applications, ed. R. Lumley (Cambridge, Woodhead Publishing Limited, 2010), pp. 49-69 (2010).
5. Laboratory materials (exercise studies).

Breakdown of average student's workload

	Hours	ECTS
Total workload	150	6,00
Classes requiring direct contact with the teacher	79	3,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	71	2,50